REMARKS

Status of the Case:

The present invention provides methods for producing *in-situ* composite solders having particulate intermetallics homogenously distributed throughout the solder matrices. The composite solder is made by mixing a conventional solder with the components of the intermetallic phase, heating the mixture until it is non-solid, and rapidly cooling. The solders of this invention provide greater solder joint strength and fatigue resistance than solders among those known in the art.

In the Office Action issued June 4, 2002, all claims were rejected under 35 U.S.C. §§102 and/or 103. The rejection was made final. In an Amendment filed September 4, 2002, Applicants traversed all rejections, and amended Claims 26, 42 and 53 to specifically address concerns raised by the Examiner. The Examiner issued an Advisory Action on September 17, 2002, stating that the amendments would not be entered, and maintaining the rejections of record.

Applicants have filed a Request for Continued Examination with this Amendment. In this Amendment, Claims 26, 42 and 53 are amended, although the claim amendments herein are slightly different than those set forth in the September 4, 2002, Amendment that were not entered. Following this amendment, Claims 26-58 remain pending. Additional remarks are also presented, responsive to the statements made by the Examiner in the Advisory Action.

Applicants' Claims comply with 35 U.S.C. § 112, first paragraphs.

[redacted]

Claims 26-58 were rejected under 35 U.S.C. § 112, first paragraph. The Examiner alleges, "The expression 'two or more metals' in instant claims 26 and 42 is not supported by the specification originally filed." Applicants traverse this rejection.

Applicants submit that one of ordinary skill in the art would fully appreciate that the claimed compositions could contain two or more metals. Binary and ternary solders are described throughout the application, in particular including the disclosure on page 7, lines 21-31 of the specification. Nevertheless, Applicants have removed the "or more" language in Claims 26 and 42 to address the Examiner's concern. (Applicants note that this amendment in no way changes the scope of the subject claims, and the claims subsume binary and ternary solders.) Applicants respectfully request that the rejection under § 112, first paragraph, be withdrawn.

Applicants' Invention is Novel.

The Examiner rejected Claims 26-30, 33-36, 38-48 and 50-58 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,527,628, Anderson et al., issued June 18, 1996. The Examiner states, "The Anderson et al. reference(s) disclose(s) the features [of Applicants' invention] including steps of combining a solder with the components of the intermetallic phases such as Cu and Ag to form a mixture (Col. 5, line 59 to Col. 6, line 12)." Applicants respectfully traverse this rejection.

Applicants respectfully submit that the Examiner has misunderstood *Anderson*. In particular, *Anderson* does not teach the steps of combining a solder with the components of an intermetallic phase. The intermetallic compounds distributed in the *Anderson* solder are formed from the solder matrix itself, rather than being added to the matrix in a separate processing step. Applicants' invention, on the other hand, starts with a solder such as that disclosed in *Anderson*.

[redacted]

The components of the intermetallic phase are then added to the solder. The composition is then processed in such a way as to create a fine dispersion of the intermetallic components within the solder matrix.

Thus, the intermetallic phase of Applicants' solders are added to, rather than made from, the solder matrix. This distinction is clear in the claims. Claims 26, 42 and 53 provide distinct steps of providing a matrix solid, and then heating that solder with the intermetallic component to form a mixture. *Anderson* does not describe or suggest such discrete steps. Rather, as quoted by the Examiner, *Anderson* simply describes a process for forming the solder itself. There is no discussion or suggestion of adding a separate intermetallic to the solder once it is formed. Moreover, *Anderson* fails to disclose a process where the solder is melted, cooled, re-melted, and then rapidly cooled, such as in Applicants' Claim 42.

In the Office Action, the Examiner further states, "Applicants argue that Anderson fails to mix an already formed intermetallic compound with a solder." Applicants respectfully submits that the Examiner has misunderstood Applicants' argument. Applicants have not asserted that the present invention relates to the mixing of a "already formed intermetallic component." Rather, the key point is that the present invention uses an already formed solder, to which an intermetallic component is added. This is not taught or suggested by *Anderson*. To further clarify this, and address the Examiner's concerns, the "components of" language has been removed from Claims 26, 42 and 53. While this in no way changes the scope of the claims, Applicants make this amendment to make clear that it is not the nature of the intermetallic component which is important to this invention. Rather, it is the addition of the intermetallic to the solder that is a key distinction over *Anderson*.

[redacted]

Applicants' Invention is also Non-obvious.

Furthermore, *Anderson* in no way suggests Applicants' invention, and thus does not render it obvious. *Anderson* focuses on a novel ternary eutectic solder as having alleged preferred characteristics. *Anderson* describes his solder as a "heretofore unknown ternary eutectic composition consisting essentially of about 93.6 weight % Sn - about 4.7 weight % Ag - about 1.7 weight % Cu having a eutectic melting temperature of about 217°C and variants of the ternary eutectic composition." *Anderson*, at Col. 2, lines 44-46, emphasis added. The composition of the *Anderson* solder is very specific, as evidenced by the "consisting essentially of" language. One of ordinary skill in the art would not expect modifications of the *Anderson* solder to be preferred. Thus, *Anderson* teaches away from modification of its disclosed eutectic solder, and does not render obvious the present invention.

Claims 37 and 49 were also rejected under 35 U.S.C. § 103 as being obvious over *Anderson* in view of Gibson, et al., Des. Reliab. Solder Interconnect., Proc. Symp. (1997). Applicants respectfully traverse this rejection, for the reasons discussed above regarding *Anderson*. *Gibson* provides no disclosure of the processes of Applicants' invention, of adding an intermetallic to an already formed solder matrix. Accordingly, *Gibson* does not remedy the deficiencies of the *Anderson* reference. The combination of these references does not render Claims 37 and 49 obvious.

The Examiner also rejected Claims 31 and 32 under 35 U.S.C. § 103 as being obvious from *Anderson* in view of U.S. Patent 5,520,752, Lucey, Jr. et al., issued May 28, 1996. Applicants' respectfully traverse this rejection. *Lucey* makes no disclosure of the methods of the present invention, and does not suggest adding the components of an intermetallic to an already

formed solder matrix. Accordingly, *Lucey* does nothing to remedy the deficiency of the *Anderson* reference, and the combination does not render Claims 31 and 32 obvious.

The Advisory Action:

In the Advisory Action, the Examiner alleged that the Applicants' arguments are "inconsistent with the instant claims which expressly recited 'the components of said intermetallic component ...' in step (b) of Claims 26, 42, and 53, not a formed intermetallic phase." Applicant respectfully submits that the Examiner has misunderstood the recited claim terminology and its relevance to the art. (This language has also been deleted from the claims.)

Applicants want to reinforce two points in response to the Examiner's statement. First, the claims do not require the addition of a "formed intermetallic phase" to the solder composition. Second, Applicants do not now argue, nor have they ever argued, the addition of a formed intermetallic phase to the solder as being the key factor in distinguishing the art.

Rather, as stated above, Applicants' invention is distinguished from the art because it involves addition of intermetallics to an already formed **solder**. The Examiner's reference to a "formed intermetallic" is inapposite and irrelevant. *Anderson* forms intermetallics during production of the solder; Applicants add intermetallics to a solder that has already been produced. Moreover, contrary to the Examiner's assertion, this difference from the art is clearly manifested in the claims. For example, Claims 26, 42 and 53 specifically set forth steps of "providing" a matrix solder step followed by a steps of "heating" the matrix solder with an intermetallic component. Such discrete steps are not found in *Anderson*, and render the claimed compositions novel and non-obvious.

[redacted]

CONCLUSION

Applicants submit that the claims comply with the provisions of 35 U.S.C. § 112, first paragraph, and define novel and non-obvious subject matter. Applicants therefore request withdrawal of the rejections of record, and allowance of all claims.

Respectfully submitted,

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[redacted]

DESCRIPTION OF CLAIM AMENDMENTS

Claims 26, 42, and 53 are amended as follows. Added language is underlined; deleted language is in brackets.

26. (amended) A method for producing an *in-situ* composite solder having an intermetallic component, comprising the steps of:

(a) providing a matrix solder comprising two [or more] metals;

(b) heating a mixture of said matrix solder with [the components of said] an intermetallic component at a temperature greater than the highest melting temperature of any of the individual components of said mixture so as to form a non-solid mixture; and

(c) cooling said non-solid mixture at a rate of at least about 100°C/second.

42. (amended) A method for producing an *in-situ* composite solder having an intermetallic component, comprising the steps of:

(a) providing a matrix solder comprising two [or more] metals;

(b) heating a mixture of said matrix solder with [the components of said] an intermetallic component at a temperature greater than the highest melting temperature of any of the individual components of said mixture so as to form a non-solid mixture;

(c) cooling said non-solid mixture to form a solid mixture;

(d) heating said solid mixture formed in step (c) to a temperature greater than the melting point of the components of said intermetallic component; and

[redacted]

(e) cooling the heated mixture of step (d) at a rate of at least about 100°C/second.

53. (amended) A method for producing an *in-situ* composite solder having an intermetallic component, comprising the steps of:

(a) providing a binary or ternary [matrix] eutectic or near eutectic <u>matrix</u> solder;

(b) heating a mixture of said matrix solder with [the components of a] <u>an</u> intermetallic component comprising a first row transition metal, at a temperature greater than the highest melting temperature of any of the individual components of said mixture so as to form a non-solid mixture; and

(c) cooling said non-solid mixture at a rate of at least about 100°C/second to form said composite solder wherein said intermetallic component has a particle size less than about 10 microns.